



## Development of Digital Comics as A Media for Biology Learning of Environmental Change for Senior High School Students

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### Article Info

Article History:

Received: April 2021

Accepted:

Published: December 2021

Keywords:

*Educational revolution 4.0,*

*Distance learning,*

*Digital biology comics,*

*Environmental change.*

### Abstract

This research is motivated by the revolution in education and distance learning. The education revolution 4.0 implements the use of technology-based learning. This is closely related to government policies to implement a distance learning system. It takes innovation and a variety of learning media that can be used for independent learning that is flexible, able to provide motivation and attraction for students to gain in-depth knowledge related to the theory that explained by teachers. Digital comic media was developed as a solution to this problem. The aims of this research are to analyze the validity and test the practicality of digital biology comic media on environmental change theory for Senior High School (SHS) students. This research was done at SMA Negeri 1 Kajen, with the design of research is the modified of Research and Development method (R&D). The small-scale test was trial in 28 students with random sampling techniques. The data collection techniques used observation, interview and questionnaire techniques which were analyzed quantitatively and qualitatively. The results of the validity of the media expert got a very valid value of 94.1% and the theory expert got a valid value of 78.5%. The results of the practicality test and the students' responses each obtained an average score of 86.74% and 94.2% in the very good category. The research results showed that the digital biology comic media was feasible and appropriate to be used as a biology learning media for environmental change theory.

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p-ISSN 2252-6579

e-ISSN 2540-833X

## INTRODUCTION

The word 'media' comes from Latin and is the plural of the word 'medium' which literally means intermediary or introduction. Tafano (2018: 105), states that learning media is a tool in the teaching and learning process to stimulate the thoughts, feelings, attention and abilities or skills of learners so that they can encourage the learning process. Learning media is very influential on student learning outcomes. The functions of learning media include increasing student interest and motivation, helping communication in the learning process, assisting in delivering abstract information and overcoming the limitations of space and time (Sadirman, 2012).

Along with the development of technology and information in this era of education revolution 4.0, the challenge is to answer the needs of educational development to create advanced, quality and quality education by implementing the use of technology-based learning (Zubaidah, 2019). Supported by the government policy regarding distance learning during the Covid-19 pandemic, the application of technology in learning really needs innovation and variety of learning media.

This need is because in the implementation of distance learning there are obstacles that hinder the learning process such as internet connection constraints, limited gadget features and boredom when learning takes place (Anugrahana, 2020). Another obstacle when learning distance is that students who do not let go of using gadgets as a means of learning will make students feel tired and bored if they have to read too long a text. This is also felt by teachers from SMA Negeri 1 Kajen. From the results of the analysis of the students' needs, it was found that the students' understanding of the theory for environmental change was not evenly distributed to all students. The learning method is dominated by presentations with printed book learning media, and students' reading interest is still in the medium category, around 30-60 minutes.

From these limitations, it takes the development of learning media with flexible media criteria, attracts students' interest and can provide knowledge about the content of theory conveyed by educators in a subject. Like other subjects, biology also requires innovation and variety of media, especially theory for environmental changes. Environmental change theory was chosen because the theme requires learning media that provides illustrations of the state of factual phenomena from the environment around students. Comic media about environmental change that displays a visual image will make it easier for students to understand the concept of environmental change. Environmental change theory will be more interesting if it uses media such as digital comics, especially in distance learning.

Digital comic media is one of the learning media that is attractive to students. E-comics are a transformation of comic media technology, starting from printed comic books to digital comics on an electronic or digital basis. Meanwhile, the use of software is felt to attract more interest and attention from students to learn because it has an attractive display. From this statement, the researcher chose to use digital comics instead of traditional comics, this has also been supported by teachers and students who can use digital media devices and can operate them. In addition, the use of a Smartphone or Android is a form of technology integration facility in learning.

Ernawati, et al. (2020), the advantages of digital comics compared to comics in printed form include: 1) Digital comics are more durable than printed comics. This is because digital comic media are stored in soft file. 2) The cost of making digital comics is cheaper and more efficient because it does not require printing costs, and materials such as ink, paper and dyes. 3) For teachers, digital comic media will be easily distributed to students via Smartphone or laptop. 4) For students, digital comic media will be very practical to use because it can be opened at any time because it is stored in the form of a file on their Smartphone.

In Irfana's research (2017), regarding its relation to the development of digital comic learning media that tests the feasibility of digital comics "Let's Learn About Virus" in SMA 11 Semarang, it was produced that digital comic media is suitable for learning biology media on virus theory in SMA. In addition, another study by Aulia (2018) which uses electronic comic media has decent results with an assessment percentage ranging from 61% -80% with interesting categories.

From this statement, this research was conducted with the aim of analyzing the validity and testing the practicality of biological digital comic media on environmental change theory.

## RESEARCH METHOD

This research used a modified Research and Development method (R&D) by Sugiyono (2015) to develop digital comic media products for biological change theory. There are seven stages of this R&D modification research, including 1) analysis of potentials and problems, conducting a needs analysis to obtain information about facts and conditions in the field, 2) data collection, searching for relevant data through literature studies to be used in the product manufacturing process, 3) product design, process of designing biological digital comic media, as follows:

**Table 1** Design of digital biology comic products

No	design aspects	Information
1	Purpose	Variations of fun learning media are used in environmental change theory that integrate technology and are not limited to space and time. Digital comics in pdf format with the appearance of webtoon comics made with Ibis paint X and CorelDraw File size <10 Mb
2	Form	Full color with simple panels and a combination dialog balloon shape Monologue and dialogue A4 paper size, Portrait with 58 pages The background story of the city of Pekalongan, the school and home environment Environmental change theory, including:
3	Theory	<ul style="list-style-type: none"> <li>- Factors causing environmental change</li> <li>- The influence of human activities on the environment</li> <li>- Kinds of environmental pollution and its impacts</li> <li>- Environmental pollution prevention efforts</li> </ul>
4	Language	Interactive and communicative Indonesian Serif font

4) design validation, assessment activities carried out by experts who are experts in their fields to test the feasibility of the media, 5) design revisions, product improvements based on validation results so that the product is feasible to be tested in learning, 6) product testing, product use trials on participants students to find out the practicality and responses of students to the products developed and 7) product revisions, product improvements based on the results of product trials so that products are feasible and practical to use in learning.

This research data includes data on media needs analysis, data from the results of validation assessment by media expert and theory expert as well as data on practicality test results and students' responses to this biological digital comic media. The data collection of needs analysis was carried out on educators and students at SMA Negeri 1 Kajen which was carried out using the method of observation, interviews with teacher and a need analysis questionnaire for students. Data collection from validation results by experts, practicality tests and student responses were carried out using a questionnaire. The sample used in the small-scale trial was 28 students from class XI MIPA using random sampling techniques. Data collection techniques were carried out using a questionnaire.

## RESULTS AND DISCUSSION

### Results of data analysis

Based on the results of the validation test, it aims to determine the feasibility of the product. The feasibility is assessed by theory and media validation standards. In this study, the aspects viewed from the theory validation were the suitability of the theory with the 2013 KI and KD curriculum, the accuracy of the theory. While the aspects viewed from media validation are the feasibility of graphics, the feasibility of

presenting or displaying the media and legibility. From the results of the validation, the following data were obtained:

**Table 2** The results of the validation of the digital biology comic media

	Media Expert Validation		Media Expert Validation	
	Skor	Skor Max.	Skor	Skor Max.
	64	68	44	56
<b>Percentage</b>	94.1%		78.5%	
<b>Category</b>	Very valid		valid	

From the results of these data, the media validation obtained a very valid value category which means that the product is feasible to be tested. However, there are suggestions and comments from the experts to make the media better. Meanwhile, the results of theory validation obtained a valid value category which also means that based on the theory aspect of the product it is feasible to be tested.

The practicality test aims to test how the use of biological digital comic media for students. There are four aspects that are assessed in this study to test the practical value. Among them are aspects of ease of understanding, aspects of independence, aspects of presentation of learning media and aspects of media use of learning media. The results of the practicality test are presented in the following table:

**Table 3** Data on the practicality test results of biological digital comic media on students

Statements	percentage	Category
The aspect of ease of understanding	85.27%	Good
Aspects of independence in learning	87.5%	Very good
Aspects of presenting learning media	83.26%	Good
Aspects of the use of learning media	91.3%	Very good
<b>Average</b>	<b>86.74%</b>	<b>Very good</b>

From the results of the practicality test, it was found that the category of value was very good, which means that the media was suitable for use in real learning.

**Table 4** Data on the results of students' responses to biological digital comic media

No.	Statement	percentage	Category
1	Ease of use of media	100%	Very good
2	Clarity of content	100%	Very good
3	Media cover design	86%	Very good
4	Text legibility	96%	Very good
5	Display / picture quality	96%	Very good
6	Interesting picture presentation	100%	Very good
7	Color composition	81%	Good
8	Language is easy to understand	96%	Very good
9	Font size	81%	Good
10	The clarity of the story line	100%	Very good
11	Appropriateness of character selection	100%	Very good
	<b>percentage</b>	<b>94.2%</b>	<b>Very good</b>

### Discussion result

This research was conducted based on the background of the educational revolution 4.0 and distance learning. The education revolution 4.0 implements the use of technology-based learning. This is closely related to government policy to implement a distance learning system, which requires a variety of interesting and flexible media. In distance learning (PJJ), students cannot be separated from their gadgets such as Smartphone or laptops as a means of learning. However, the disadvantages of distance learning

using a Smartphone or laptop will make students feel tired and bored if they have to read too long a text. This is a big challenge for educators in making innovations and variations of learning media that are attractive and easily understood by students.

No different in all subjects, an educator who teaches biology theory also needs innovation and a variety of learning media that can be used to solve these problems. Supported by the statement of Muhson (2010) that in a lesson, variations and modifications of learning media need to be done so that a learning process does not seem less attractive, monotonous, and boring so that it can increase the effectiveness and efficiency of learning. To answer these challenges, digital comic media development solutions as learning media are very useful. One of them is creating digital comic media with the theme of environmental change. Of course, in media development, we pay attention to facilities, skills, and interest in the media to be used.

Environmental change theory was chosen because the theme requires learning media that provides illustrations of the state of factual phenomena from the environment around students. Comic media about environmental change that displays a visual image will make it easier for students to understand the concept of environmental change. Environmental change theory will be more interesting if it uses media such as digital comics, especially in distance learning.

In the development of digital comic media, it must go through the validation stage carried out by media expert and theory expert before being tested on students. Product validation is carried out to determine the feasibility of the product before being tested. Validation includes several aspects that are used as standards in product appraisal. This comic media has passed the validation stage and is feasible to be tested on students.

In the digital comic media trial, students were given two questionnaires in the form of a practicality test questionnaire and responses to digital comic media. In the practicality questionnaire there is a practicality standard that is used so that the media is said to be practical. Media is said to be practical in this study, in terms of four aspects, namely 1) ease of understanding, 2) independence in learning, 3) presentation of media and 4) use of media.

The value of practicality in the aspect of ease of understanding gets a good average score. There are three things that support this aspect, namely students can gain in-depth knowledge, easily understand the theory presentation and can analyze the relationship between human activities and their impact on environmental changes.

Obtaining in-depth knowledge on this aspect of environmental change theory using digital comic media gets a good value category. In-depth understanding indicators are closely related to students' interest in the content of the theory. This interest triggers the motivation of students so that they are actively involved in learning, so that they will gain in-depth knowledge (Otto, 2020: 808).

Things that support the interest of students from the results of validation by experts, there is a statement in the questionnaire that comic media can foster a sense of curiosity in studying the theory after using the media, obtaining a valid category value. According to Fandakova's (2020) statement, curiosity has a positive impact on students' memories of the theory to be received. In his research, it shows that students tend to remember the answers to the questions they want to ask in class.

Another thing that supports interest in learning is media presentation. From the results of students' responses to digital comic learning media, they received very good scores. Supported by Suparman's (2020) statement that reading interest and learning outcomes are influenced by media presentation. Attractive media are presented in pictorial reading form, in color and visualized in cartoon or realist form.

In addition to the interest and presentation of the media, the acquisition of in-depth knowledge is also supported by the results of validation of the suitability, accuracy and depth of the content of environmental change theory with the core competencies and basic competencies of the 2013 curriculum which are valid.

Another review of this aspect is the ease of understanding the theory presented in digital comic media. The factor that supports students to easily understand the theory is the use of language. The use of communicative language can cause pleasure when reading and encourage students to read thoroughly.

The language used to explain theory in digital comic media uses language that is in accordance with the thinking abilities of students. Novarya (2020) reveals that the use of non-standard or formal language is more often used by students in communicating with their peers. They feel that the use of the language is easier for them to understand and more flexible to apply.

The ease of analyzing the relationship between human activities and their impact on environmental changes gets a good category value. This statement is supported by the valid value of the validation results which states that digital comic media is appropriate in providing examples of environmental change theory, the integration of the storyline with environmental change theory, the clutter and the systematic presentation of the theory presented and the suitability of the theory with the concepts, facts, and theories there is.

In digital comic media, an illustration appears that illustrates the problems that arise from the impact of environmental changes that occur in the environment around students, so that students are expected to be able to generate a sense of curiosity and prepare students to think critically, analyze and be able to use learning media appropriately. As stated by Nasution (2020), students who learn using factual problems as a context for learning will be motivated to bring up critical thinking styles and problem-solving skills, as well as acquire essential knowledge and concepts from the subject.

Another aspect is independence in learning. In this aspect, students who are interested in studying environmental change theory can use digital comic media to learn anytime and anywhere without being limited by space and time.

From the aspect of independent learning, it gets very good grades. A similar statement was stated by İlhan (2020), that one of the problems of distance learning is limited communication and the pattern of playing time during distance learning which is different from during formal learning. Limited communication causes communication on effective face-to-face learning cannot be achieved in PJJ.

Factors from communication limitations such as limited features of gadgets, network connections and so on. In addition, the time spent by students during PJJ is mostly spent in the house which causes boredom when learning takes place. So that the use of digital comics is a good solution for independent learning that is fun for students, especially during distance learning.

Furthermore, the aspect of presenting learning media. According to Ilzzah (2020), the criteria for a good comic are viewed from the clarity of the storyline, the presentation of language and text, the presentation of illustration images and character images, and color composition. From the aspect of presenting learning media, this digital biology comic media has received good marks.

This was confirmed by the media expert, where for the presentation of the text, including choosing the appropriate font, it got a very valid value, the font chosen in digital comic media was a Serif font type that was firm and clearly legible. Furthermore, the text size is comfortable to read for students. In addition, the advantage of digital comics is that there is a zoom feature on the gadget that can enlarge and reduce writing so that readers feel more comfortable.

The cohesiveness and timeliness of the story line that contains the theory. The storyline depicted in an illustration that leads to understanding the concept in digital comic media is also very valid. The illustrations used in the media are color images so that they attract the attention of the readers. Choosing the appropriate color composition also supports the harmony of the story in the comics.

The last aspect is the aspect of using digital comic media. In this aspect, it is viewed from the ease of learning, easy use, and can be a medium for learning and entertainment. The results of this aspect get very good scores. The use of digital comic media uses gadgets that are familiar to students. Comics with Portable Document Format (PDF) can be accessed by using a document reader application which is usually available on the gadget feature.

In addition to the practicality test results, there was also data on students' responses to digital biology comic media which received very good scores. The results of this positive response indicate that overall digital comic media for learning biology, environmental change theory can attract the attention of students.

## CONCLUSION

The conclusion that can be drawn in this study is that digital comic media is feasible and practical to use in learning biology theory for environmental change. Especially in distance learning to support students' independent learning. Of course, this research has research limitations, from this it is hoped that the next researcher will pay attention to these limitations as a reference for improvement in future research, including multiplying samples by conducting large-scale tests so that the data is more representative of the real data and the application of media in face-to-face learning in order to know the activeness of students when using digital comic learning media.

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